Thermochromatographic Separation of Actinides on Metal Columns

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We began investigations of Lr, the last member of the actinide series, in continuation of the thermochromatographic adsorption studies of heavy actinides on metal columns [1, 2]. A ^{249}Bk/^{249}Cf target was bombarded with 93-MeV ^{18}O projectiles at the LBNL 88-Inch Cyclotron in order to produce ^{261}Lr via the ^{249}Bk(^{18}O, α2n)^{261}Lr reaction. The ^{261}Lr production cross section was estimated to be about 8 nb. The recoiling nuclei from the nuclear reaction were caught in 4-µm Zr foils. ^{261}Lr is a spontaneously fissioning isotope with a half-life of 39 min. In order to measure Lr by fission counting, spontaneously fissioning nuclides like ^{256}Fm must be completely separated from the Lr. We expected high decontamination factors for the separation of metallic divalent actinides from the trivalent actinides because Lr is adsorbed onto metals in the metallic trivalent state and not in the divalent state, as predicted by theoretical relativistic calculations.

The experimental setup of the thermochromatography was similar to the one described in [1, 2]. Columns of Nb and Ta foils, supported by sapphire tubes, were used as thermochromatographic columns. The starting temperature of the thermochromatography was 1930 K. After the thermochromatography, the nuclide distribution along the column was determined off-line by α spectroscopy of 2-cm column pieces.

The main α activities were caused by ^{248}Cf and ^{250}Cf, which are the β^--decay products of ^{248}Bk and ^{250}Bk formed via transfer reactions. Bk served as model element for the metallic trivalent actinides. Bk was nearly completely separated from the simultaneously produced Fm. Both Bk isotopes were deposited on Nb at an oven position of 30-38 cm corresponding to a deposition temperature of about 1630 K (Fig. 1). Fm was deposited at significantly lower temperatures [2]. Only 3 α-decay events were detected in the energy range of 7.02 ± 0.1 MeV which is characteristic for ^{252}Fm and ^{255}Fm. A decontamination factor of about 10^6 was calculated from a comparison with the total amount of Fm as evaluated from the cross sections given in [3, 4].

Although no ^{261}Lr could be unambiguously identified in this experiment as a result of the low cross section, the excellent separation of Fm from the metallic trivalent Bk encourages us to continue our efforts to characterize Lr using thermochromatography on metal columns.

Footnotes and References

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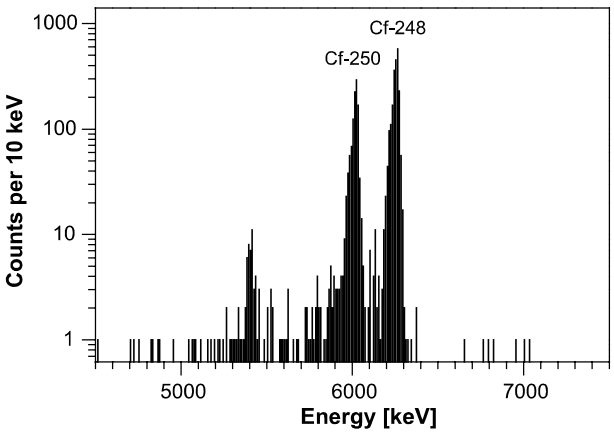

Fig. 1. Sum spectrum of Nb column sections at the position of the Bk peak (30 – 38 cm)